

PRELIMINARY DATA SUMMARY

July 1990

U.S. Army Engineer Waterways Experiment Station  
Coastal Engineering Research Center  
Field Research Facility  
Duck, North Carolina

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CERC Field Research Facility  
Duck, North Carolina

This report provides a summary of basic oceanographic, meteorological and bottom profile data for the month. The data were obtained as part of the Measurements and Analysis work units at the U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's Field Research Facility (FRF) in Duck, North Carolina. The FRF staff collected and analyzed these data. These summaries are intended to make the data readily available to all FRF users, and comments on their content and usefulness are invited.

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## PART I: INTRODUCTION

The U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's (CERC's) Field Research Facility (FRF) is located on the Outer Banks of North Carolina, near the village of Duck (Figure 1).

The FRF research program provides a means for obtaining high-quality field data, particularly during storms, in support of the U.S. Army Corps of Engineers' coastal engineering research missions. The research pier is a reinforced concrete structure supported on 0.9-m-diam steel piles spaced 12.2 m apart along the pier's length and 4.6 m apart across the width. The pier deck is 6.1 m wide and extends from behind the duneline to about the 6-m water depth contour at a height of 7.6 m above the National Geodetic Vertical Datum (NGVD). In addition, a main building contains offices, an instrument repair shop, and a data acquisition room.

One of the responsibilities of the FRF research program is the collection, analysis and dissemination of data on local oceanographic and meteorological conditions. Bottom profiles along both sides of the pier and periodic bathymetric surveys are also performed.

This summary is intended to provide basic data as soon as possible after they are obtained. Questions and/or comments concerning the data may be directed to Mr. Michael W. Leffler at (919) 261-3511.

Part II presents the meteorological data; Parts III through VI present oceanographic data; Part VII presents nearshore profiles and bathymetry; and Part VIII, if included, documents special events that occurred at the FRF during the month.

Table 1 is a list of instruments used, their operational status during the month, and the data collection status. Figure 2 identifies the location of the instruments. The water depths at the wave gages and current meters vary and may be determined from information contained in Figure 7. Other installation information is contained in Table 1.

Times given in the report, unless otherwise specified, are referenced to eastern standard time (EST).

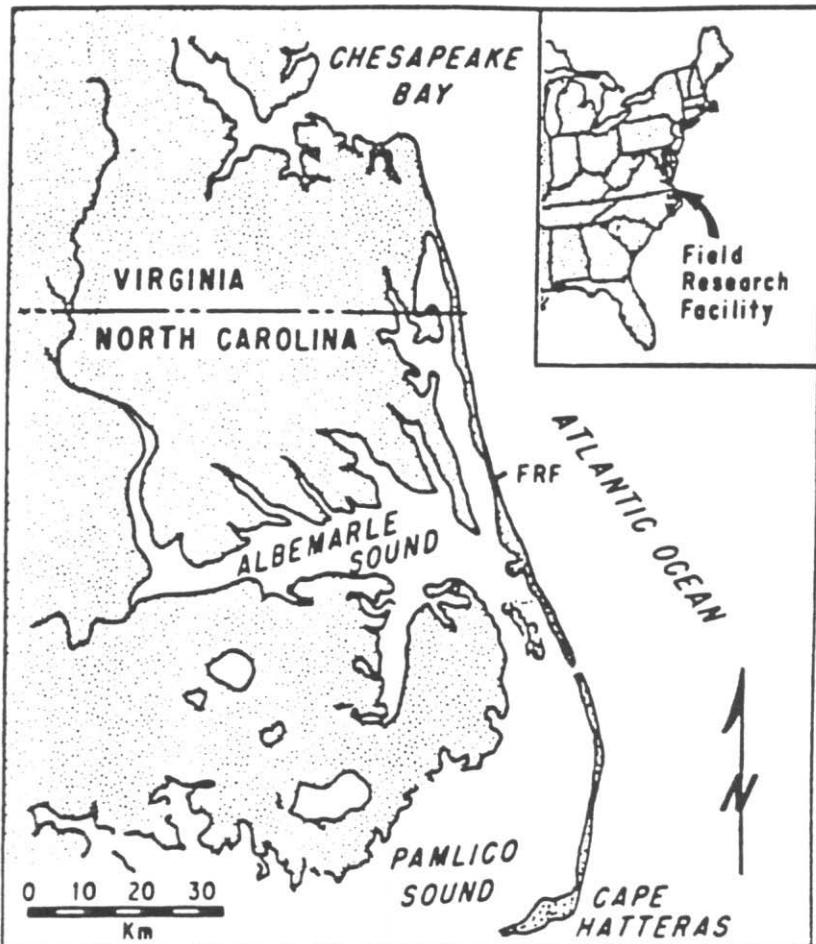


Figure 1. FRF location map

Table 1: Instrument Status/Data Availability

JUL 1990

Gage ID	Description/Remarks	Depth at Sensor		Day of the month																																																	
				1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	3																
616	Barometric Pressure		Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*												
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*												
			Analog Record	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*												
604	Precipitation		Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*											
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*											
624	Air Temperature		Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*											
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*											
932	Anemometer at seaward end of pier Elevation 19 m (NGVD)		Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*										
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*									
645	Baylor staff at station 7+80 on FRF pier	see Figure 7	Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*										
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*								
625	Baylor staff at station 18+60 on FRF pier	see Figure 7	Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*									
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*							
111	Pressure gage 309 m north of FRF pier (0.9 km offshore)	Approx. 7.8 m NGVD	Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*									
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*							
630	Waverider buoy 6.0 km offshore	Approx. 23 m NGVD	Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*							
			Data Collected	/	*	/	*	/	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*						
519	Current meter 320 m north of FRF pier (0.9 km offshore)	see Figure 7	Gage Status	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
			Data Collected	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-											
865-1370	NOAA tide station at seaward end of FRF pier		Gage Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*				
			Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
	Supplemental Observations (daily oceanographic and meteorological observations)		Daily observation	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

Gage Status	Daily Observation	Analog Record	Data Collected
Operational = *	Complete = *	Complete = *	All = *
Partial = /	Partial = /	Partial = /	Partial = /
Non-Operational = -	None = -	None = -	None = -

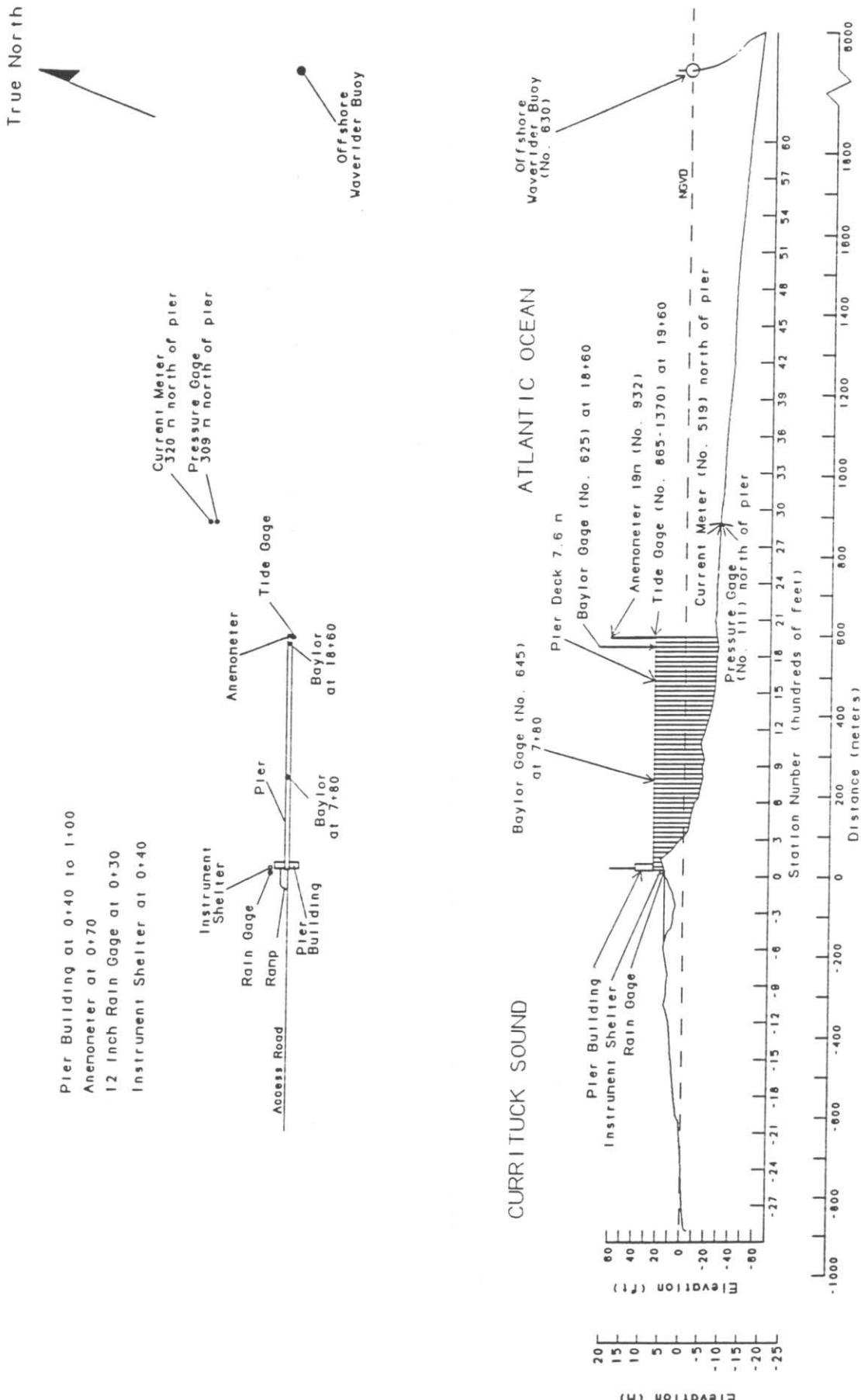


Figure 2. Instrument locations at FRF (all elevations from NGVD, all distances from PRF baseline).

## PART II: METEOROLOGICAL DATA

A variety of instruments have been installed at the FRF (Figure 2) to monitor the meteorological conditions. The data presented in Table 2 are collected and stored on magnetic tape using a Digital Equipment Corporation VAX 11/750. For each instrument identified in Table 1 as having analog outputs, chart records are obtained, a log is maintained and the records are stored for future reference.

Winds were measured at the end of the pier at an elevation of 19 m (Figure 2) using a Weather Measure Skyvane anemometer.

Monthly resultant wind speeds and directions are determined by vector averaging the data. Temperature and atmospheric pressure means are the average of the values presented for the month. Total precipitation is the sum for the month.

The following may be useful for converting the data in Table 2 to other frequently used units of measurement:

1. Millimeters (mm) to inches (in.) -  
 $mm \times .03937 = in.$
2. Millibars (mb) to inches of mercury (in. Hg) -  
 $mb \times 0.02953 = in. Hg$
3. Degrees Celsius (C) to degrees Fahrenheit (F) -  
 $(C \times 9/5) + 32 = F$
4. Meters per second (m/s) to knots (kn) -  
 $m/s \times 1.943 = kn$

Table 2: Meteorological Data

Jul 1990

Day	Hour	Wind Speed m/sec	Wind Direction deg TN	Temperature deg C	Atm Pressure mb	Precipitation mm
1	100	7	280	22.7	1010.4	0
	700	1	340	24.1	1008.1	3
	1300	3	34	28.4	1006.7	0
	1900	17	10	20.5	1006.7	19
2	100	6	287	21.2	1006.0	4
	700	8	354	22.3	1009.1	0
	1300	11	5	23.6	1010.4	0
	1900	6	39	21.9	1013.1	0
3	100	5	14	21.1	1015.5	0
	700	5	32	22.7	1017.2	0
	1300	2	84	26.0	1018.2	0
	1900	5	133	22.8	1017.2	0
4	100	7	208	22.4	1017.9	0
	700	7	229	24.2	1018.9	0
	1300	6	235	29.3	1016.5	0
	1900	6	202	28.2	1013.8	0
5	100	10	223	24.7	1012.8	0
	700	8	240	25.4	1013.1	0
	1300	5	222	31.7	1010.4	0
	1900	3	238	29.6	1009.1	0
6	100	3	231	27.1	1008.4	0
	700	7	336	24.2	1009.1	0
	1300	4	13	27.4	1009.8	0
	1900	5	45	24.8	1010.8	0
7	100	5	53	23.4	1013.1	0
	700	7	57	23.2	1015.9	0
	1300	6	76	25.2	1018.2	0
	1900	8	77	23.0	1018.9	0
8	100	8	76	23.1	1019.9	0
	700	6	100	25.0	1020.9	0
	1300	7	129	27.8	1020.9	0
	1900	8	146	24.4	1019.2	0
9	100	4	199	25.3	1018.9	0
	700	6	220	25.6	1019.2	0
	1300	7	220	31.8	1015.9	0
	1900	7	204	29.6	1013.8	0
10	100	9	231	27.2	1013.8	0
	700	10	249	27.1	1014.5	0
	1300	4	251	32.8	1014.2	0
	1900	5	211	31.1	1012.5	0
11	100	7	254	27.3	1014.8	0
	700	7	238	27.1	1014.8	0
	1300	6	212	31.1	1014.5	0
	1900	9	203	29.4	1012.8	0
12	100	7	216	26.8	1015.5	0
	700	9	222	27.7	1014.8	0
	1300	9	211	32.9	1013.8	0
	1900	10	210	29.5	1013.1	0
13	100	10	223	26.9	1015.5	0
	700	8	232	28.1	1016.5	0
	1300	4	166	28.5	1016.5	0
	1900	7	189	26.8	1015.9	0
14	100	5	179	24.5	1016.5	0
	700	5	155	23.1	1016.2	0
	1300	10	148	26.3	1014.8	0
	1900	8	184	27.6	1014.2	0
15	100	7	207	26.1	1014.2	0
	700	9	198	25.9	1014.8	0
	1300	9	201	26.8	1015.9	4
	1900	9	201	26.0	1015.9	0
16	100	6	220	25.8	1018.2	0
	700	6	238	26.1	1020.9	0
	1300	5	163	27.6	1021.3	0
	1900	5	227	26.9	1021.3	0

\* electronic problems

(Continued)

Table 2: Meteorological Data

Jul 1990

Day	Hour	Wind Speed m/sec	Wind Direction deg TN	Temperature deg C	Atm Pressure mb	Precipitation mm
17	100	4	234	25.1	1022.6	0
	700	3	219	26.7	1024.0	0
	1300	5	180	27.9	1023.3	0
	1900	5	186	25.1	1022.3	0
18	100	2	125	22.6	1022.6	0
	700	1	139	25.4	1022.3	0
	1300	5	133	28.6	1021.3	0
	1900	4	148	25.3	1019.6	0
19	100	3	205	25.3	1019.6	0
	700	3	143	24.7	1019.6	0
	1300	*		28.5	1019.6	0
	1900	*		26.1	1018.2	0
20	100	*		25.8	1017.9	0
	700	*		26.0	1018.2	0
	1300	*		30.0	1016.5	0
	1900	7	196	27.7	1014.5	0
21	100	8	230	26.5	1014.8	0
	700	5	231	26.3	1014.5	0
	1300			System down for repair		
	1900					0
22	100	*		25.4	1011.1	0
	700	*		26.8	1011.4	0
	1300	*		31.6	1011.1	0
	1900	*		28.2	1009.8	0
23	100	*		27.1	1010.1	0
	700	*		28.2	1009.8	0
	1300	*		32.5	1009.4	0
	1900	*		26.0	1009.1	0
24	100	*		25.8	1010.8	0
	700	*		23.8	1012.5	0
	1300	*		26.0	1014.2	0
	1900	5	8	23.9	1013.5	0
25	100	3	22	23.3	1014.5	0
	700	7	353	24.5	1016.2	0
	1300	7	11	27.0	1016.9	0
	1900	7	17	24.9	1016.9	0
26	100	8	8	24.6	1017.2	0
	700	10	22	25.1	1017.9	0
	1300	11	14	26.3	1017.5	0
	1900	10	10	24.6	1016.9	0
27	100	3	108	24.4	1015.9	0
	700	7	142	24.1	1015.2	0
	1300	4	55	27.7	1016.9	0
	1900	7	64	24.9	1016.9	0
28	100	6	68	24.3	1015.9	0
	700	7	21	25.5	1015.5	0
	1300	8	38	25.8	1015.5	0
	1900	5	54	24.8	1014.5	0
29	100	6	45	24.4	1012.8	0
	700	7	19	25.6	1012.8	0
	1300	7	32	26.8	1012.1	0
	1900	7	34	25.4	1011.1	0
30	100	7	26	24.8	1010.8	0
	700	8	7	25.4	1011.1	0
	1300	7	19	27.0	1011.1	0
	1900	1	117	24.6	1009.4	0
31	100	3	199	24.3	1009.4	0
	700	5	235	26.7	1009.1	0
	1300	5	204	32.1	1008.1	0
	1900	2	43	28.2	1008.4	0
		<u>Resultant</u>		<u>Mean</u>	<u>Mean</u>	<u>Total</u>
		1	203	26.2	1014.9	30

\* electronic problems

(Sheet 2 of 2)

### PART III: WAVE DATA

Wave data are collected from two Baylor staff gages (Gages 625 and 645), a pressure wave gage (Gage 111) and a Waverider buoy (Gage 630) as shown in Table 1 and Figure 2. The data are collected, analyzed, and stored on magnetic tape using a Digital Equipment Corporation VAX 11/750 programmed to sample the wave gages every 6 hr (more frequently during storms) beginning at 0100, 0700, 1300, and 1900 EST. The sampling rate is two times per second for four contiguous 34-min records.

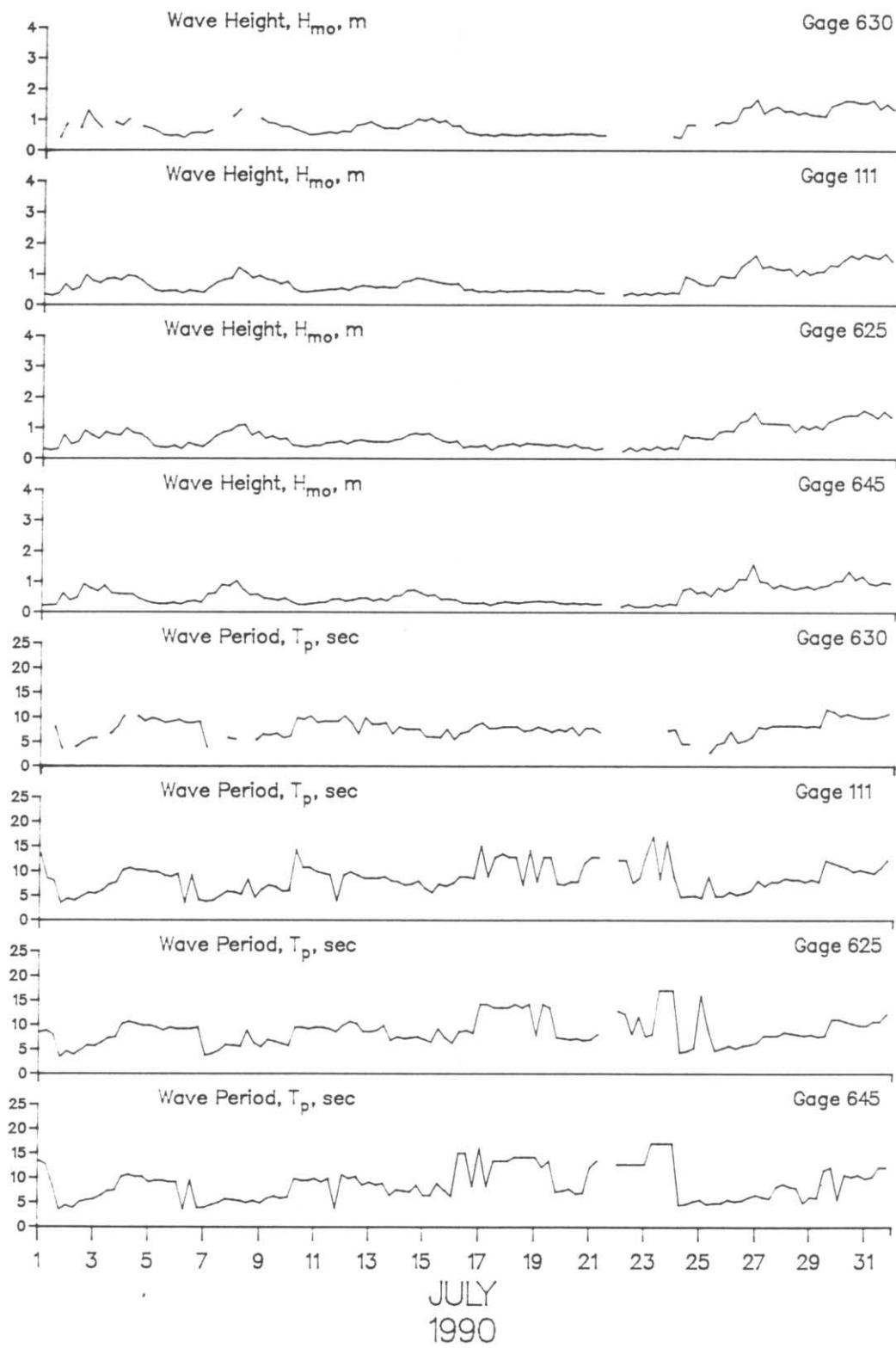
Wave height  $H_{mo}$  is an energy-based statistic equal to four times the standard deviation of the sea surface elevations. Wave height reported from the pressure gage has been compensated for hydrodynamic attenuation using linear wave theory. Wave period is identified from the computation of a variance (energy) spectrum with 60 deg of freedom calculated from a 34-min record. Peak wave period  $T_p$  is defined as the period associated with the maximum energy in the spectrum. When this analysis is complete, the data are written to magnetic tape.

Table 3 presents the wave heights and periods for each wave record obtained at 6 hr intervals during the month. The monthly means and standard deviations from the means shown in Table 3 are average values computed from this data. Figure 3 is a time history of all  $H_{mo}$  and  $T_p$  values obtained for all gages.

Differences in wave periods between wave gages (Table 3 and Figure 3) may be the result of wave breaking, wave reformation, or the presence of multiple wave trains containing nearly equal energy.







#### PART IV: CURRENT DATA

Current data (Table 4) are collected from a Marsh-McBirney electromagnetic biaxial current meter (Table 1 and Figure 2) and by visually observing the movement of dye on the water surface in the surf and at the seaward end of the pier, as well as 500 m updrift of the pier 12 m offshore.

Since the shoreline orientation is approximately N20W, longshore currents flow either toward 340 deg (i.e. northward) or toward 160 deg (i.e. southward). Similarly, cross-shore currents are either onshore (westward) or offshore (eastward).

All current speeds are given in centimeters per second (cm/sec). Resultant speeds and directions are determined by vector averaging the data.

Table 4: Current Data  
Jul 1990

Alongshore Cross-shore Resultant Time Day	Pier Measurements			Beach Measurements (500m Updrift)			Current Meter					
	Dye at (579 m) (surface)	Speed	Dir	Dye at Mid-Surf Zone (surface)	Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir	0.9 km Offshore Depth -5.6m (NGVD) ID #519
1 0100-Along Cross Result												
1 0700-Along Cross Result	10 3 10	N off 357		128		23 9 24	N off 2	11	N			
1 1300-Along Cross Result												
1 1900-Along Cross Result												
2 0100-Along Cross Result												
2 0700-Along Cross Result	87 13 88	N off 349		128		51 3 51	S on 163	61	S			
2 1300-Along Cross Result												
2 1900-Along Cross Result												
3 0100-Along Cross Result												
3 0700-Along Cross Result	47 9 48	S on 171		140		68 3 68	S off 157	42	S			
3 1300-Along Cross Result												
3 1900-Along Cross Result												
4 0100-Along Cross Result												
4 0700-Along Cross Result	19 24 30	N off 31		152		9 27 29	S off 88	71	S			
4 1300-Along Cross Result												
4 1900-Along Cross Result												
5 0100-Along Cross Result												
5 0700-Along Cross Result	3 14 15	N off 58		128		47 2 47	N off 343	48	N			
5 1300-Along Cross Result												
5 1900-Along Cross Result												

KEY = All speeds in cm/sec  
 N = Northward, Shore parallel  
 S = Southward, Shore parallel  
 on = onshore off = offshore

Table 4: Current Data (Continued)  
Jul 1990

Alongshore Cross-shore Resultant ---- Time Day	Pier Measurements				Beach Measurements (500m Updrift)				Current Meter	
	Dye at (579 m) (surface)	Distance from Baseline (m)	Dye at Mid-Surf Zone (surface)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir	0.9 km Offshore Depth -5.6m (NGVD) ID #519
6 0100-Along Cross Result										
6 0700-Along Cross Result	29 0 29	S 160	128	29 3 29	S off 154		North	26	S	
6 1300-Along Cross Result										
6 1900-Along Cross Result										
7 0100-Along Cross Result										
7 0700-Along Cross Result	34 15 37	S off 136	140	29 0 29	S 160		North	26	S	
7 1300-Along Cross Result										
7 1900-Along Cross Result										
8 0100-Along Cross Result										
8 0700-Along Cross Result	11 1 11	N on 334	140	55 6 56	N off 346		South	17	N	
8 1300-Along Cross Result										
8 1900-Along Cross Result										
9 0100-Along Cross Result										
9 0700-Along Cross Result	15 17 23	N off 30	128	102 0 102	N off 340		South	71	N	
9 1300-Along Cross Result										
9 1900-Along Cross Result										
10 0100-Along Cross Result										
10 0700-Along Cross Result	5 15 16	N off 52	128	34 0 34	N off 340		South	10		
10 1300-Along Cross Result										
10 1900-Along Cross Result										

KEY = All speeds in cm/sec  
 N = Northward, Shore parallel  
 S = Southward, Shore parallel  
 on = onshore off = offshore

Table 4: Current Data (Continued)  
Jul 1990

Alongshore Cross-shore Resultant Time Day	Pier Measurements			Beach Measurements			Current Meter	
	Dye at (579 m) (surface)	Distance from Baseline (m)	Speed Dir	Dye at Mid-Surf Zone (surface)	Location	12m offshore (surface)	Speed Dir	0.9 km Offshore Depth -5.6m (NGVD) ID #519
11 0100-Along Cross Result								
11 0700-Along Cross Result	76 15 78	S off 149		140	5 1 5	N off 354	22 N	
11 1300-Along Cross Result								
11 1900-Along Cross Result								
12 0100-Along Cross Result								
12 0700-Along Cross Result	22 36 42	N off 39		136	102 41 109	N off 2	20 N	
12 1300-Along Cross Result								
12 1900-Along Cross Result								
13 0100-Along Cross Result								
13 0700-Along Cross Result	8 16 18	N off 43		140	87 30 92	N on 321	67 N	
13 1300-Along Cross Result								
13 1900-Along Cross Result								
14 0100-Along Cross Result								
14 0700-Along Cross Result	3 6 7	N on 277		140	38 38 54	N on 295	12 S	
14 1300-Along Cross Result								
14 1900-Along Cross Result								
15 0100-Along Cross Result								
15 0700-Along Cross Result	27 13 30	N off 7		152	87 65 109	N on 303	57 N	
15 1300-Along Cross Result								
15 1900-Along Cross Result								

KEY = All speeds in cm/sec

N = Northward, Shore parallel

S = Southward, Shore parallel

on = onshore off = offshore

Table 4: Current Data (Continued)  
Jul 1990

Alongshore Cross-shore Resultant Time Day	Pier Measurements				Beach Measurements (500m Updrift)				Current Meter	
	Dye at (579 m) (surface)	Distance from Baseline (m)	Dye at Mid-Surf Zone (surface)	Speed Dir	Dye 12m offshore (surface)	Location	Speed Dir	0.9 km Offshore Depth -5.6m (NGVD) ID #519	Speed	Dir
16 0100-Along Cross Result										
16 0700-Along Cross Result	12 7 off	N 11	140	47 7 on	N 331	South	48 N			
16 1300-Along Cross Result										
16 1900-Along Cross Result										
17 0100-Along Cross Result										
17 0700-Along Cross Result	4 0 4	N 340	154	76 0 76	N 340	South	28 N			
17 1300-Along Cross Result										
17 1900-Along Cross Result										
18 0100-Along Cross Result										
18 0700-Along Cross Result	34 14 36	S on 182	140	68 17 70	N on 326	South	39 N			
18 1300-Along Cross Result										
18 1900-Along Cross Result										
19 0100-Along Cross Result										
19 0700-Along Cross Result	15 4 15	S on 174	131	87 13 88	N on 331	South	50 N			
19 1300-Along Cross Result										
19 1900-Along Cross Result										
20 0100-Along Cross Result										
20 0700-Along Cross Result	14 6 16	S off 136	128	61 27 67	N on 316	South	51 N			
20 1300-Along Cross Result										
20 1900-Along Cross Result										

KEY = All speeds in cm/sec  
 N = Northward, Shore parallel  
 S = Southward, Shore parallel  
 on = onshore off = offshore

Table 4: Current Data (Continued)  
Jul 1990

Alongshore Cross-shore Resultant Time Day	Pier Measurements				Beach Measurements (500m Updrift)				Current Meter	
	Dye at (579 m) (surface)		Distance from Baseline (m)		Dye 12m offshore (surface)		Location	Speed	Dir	0.9 km Offshore Depth -5.6m (NGVD) ID #519
	Speed	Dir	Speed	Dir	Speed	Dir	Speed	Dir	Speed	Dir
21 0100-Along Cross Result										
21 0700-Along Cross Result	0				41	N				
	16	off	128		10	on				
	16	70			42	326	South	24	N	
21 1300-Along Cross Result										
21 1900-Along Cross Result										
22 0100-Along Cross Result										
22 0700-Along Cross Result	29	S			2	S				
	4	off	128		5	off				
	29	151			5	88	North	12	S	
22 1300-Along Cross Result										
22 1900-Along Cross Result										
23 0100-Along Cross Result										
23 0700-Along Cross Result	44	S			20	N				
	2	off	119		0					
	44	157			20	340	South	23	S	
23 1300-Along Cross Result										
23 1900-Along Cross Result										
24 0100-Along Cross Result										
24 0700-Along Cross Result	47	S			68	S				
	23	on	128		34	on				
	52	187			76	187	North	66	S	
24 1300-Along Cross Result										
24 1900-Along Cross Result										
25 0100-Along Cross Result										
25 0700-Along Cross Result	44	S			47	S				
	11	on	128		0					
	45	174			47	160	North	55	S	
25 1300-Along Cross Result										
25 1900-Along Cross Result										

KEY = All speeds in cm/sec  
 N = Northward, Shore parallel  
 S = Southward, Shore parallel  
 on = onshore off = offshore

Table 4: Current Data (Continued)  
Jul 1990

Alongshore Cross-shore Resultant Time Day	Pier Measurements						Beach Measurements			Current Meter	
	Dye at (579 m) (surface)		Dye at Mid-Surf Zone (surface) Distance from Baseline (m)		(500m Updrift)		Dye 12m offshore (surface)		0.9 km Offshore Depth -5.6m (NGVD) ID #519		
	Speed	Dir		Speed	Dir	Location	Speed	Dir	Speed	Dir	
26 0100-Along Cross Result											
26 0700-Along Cross Result	36 22 42	S on 191	152	87 39 95	S on 184	North	62	S			
26 1300-Along Cross Result											
26 1900-Along Cross Result											
27 0100-Along Cross Result											
27 0700-Along Cross Result	5 0 5	N on 340	140	102 15 103	N on 331	South	102	N			
27 1300-Along Cross Result											
27 1900-Along Cross Result											
28 0100-Along Cross Result											
28 0700-Along Cross Result	36 14 39	S on 182	140	102 5 102	N on 337	South	81	N			
28 1300-Along Cross Result											
28 1900-Along Cross Result											
29 0100-Along Cross Result											
29 0700-Along Cross Result	28 6 28	S on 171	140	76 34 84	N on 316	South	134	N			
29 1300-Along Cross Result											
29 1900-Along Cross Result											
30 0100-Along Cross Result											
30 0700-Along Cross Result	36 0 36	S on 160	140	5 4 6	N off 17	South	114	N			
30 1300-Along Cross Result											
30 1900-Along Cross Result											

KEY = All speeds in cm/sec  
N = Northward, Shore parallel  
S = Southward, Shore parallel  
on = onshore off = offshore

Table 4: Current Data (Concluded)  
Jul 1990

Alongshore Cross-shore Resultant ---- Time Day	Pier Measurements				Beach Measurements				Current Meter	
	Dye at (579 m) (surface)	Distance from Baseline	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir	0.9 km Offshore Depth -5.6m (NGVD) ID #519	
31 0100-Along Cross Result										
31 0700-Along Cross Result	3 S 1 off 3 149	152	87 414 423	N on 262		South	51	N		
31 1300-Along Cross Result										
31 1900-Along Cross Result										

KEY = All speeds in cm/sec  
 N = Northward, Shore parallel  
 S = Southward, Shore parallel  
 on = onshore      off = offshore

## PART V: SUPPLEMENTAL OBSERVATIONS

Visual wave direction measurements (Table 5) of both the primary wave train (i.e. that having the larger wave heights) and the secondary wave train (which must be clearly distinguishable as a wave train separate from the primary waves but not surface chop or capillary waves) are taken daily at the seaward end of the pier. The direction of the primary wave train just north of the seaward end of the pier is also determined using a Raytheon Marine Pathfinder radar and measuring the alignment of the wave crests at approximately the same location as the visual measurements. The pier axis (considered perpendicular to the beach at the FRF) is orientated 70 deg east of true north; consequently, wave angles greater than 70 deg indicate that the waves were coming from the south side of the pier.

The width of the surf zone (seawardmost breaker position to shoreline) is determined from the pier deck.

Measurements of surface water temperature, density, and visibility are also taken daily at the seaward end of the pier. A jar along with a thermometer is lowered about 0.3 m into the water and allowed to remain for at least one minute. The jar is removed, the temperature read, and a hydrometer is used to determine the density. A Secchi disc is used to determine the surface visibility.

Table 5: Supplemental Observations

Jul 1990

Day	Time	Wave Approach		Radar Wave Angle deg from True N	Width of Surf Zone.m	Water Characteristics at Pier End		
		Primary	Secondary			Temp.,C	Density g/cc	Secchi Vis.,m
1	0715	95	15		30	18.3	1.0236	7.0
2	0704	20		40	29	22.2	1.0212	4.3
3	0702	50		55	72	23.9	1.0203	4.6
4	0706	50			73	23.3	1.0212	2.1
5	0712	95			30	19.4	1.0236	4.0
6	0726	85	15	15	23	24.4	1.0217	5.2
7	0655	50	85		34	25.6	1.0172	4.9
8	0659	80	60		59	25.6	1.0173	2.4
9	0713	105			41	19.4	1.0231	3.7
10	0701	100			29	18.9	1.0240	3.4
11	0720	90	115		41	25.0	1.0196	4.0
12	0720	110	120		40	20.6	1.0232	3.7
13	0714	105			47	19.4	1.0248	3.4
14	0720	100	65		46	20.6	1.0238	5.8
15	0615	95	145		73	18.9	1.0246	3.7
16	0716	100			43	18.2	1.0244	4.6
17	0715	120			46	20.0	1.0246	4.6
18	0714	125			46	24.4	1.0198	6.4
19	0710	100			32	22.8	1.0204	5.8
20	0720	105	120		27	21.1	1.0235	5.2
21	0646	105	120		30	18.3	1.0237	4.0
22	0736	115		inoperative	21	18.9	1.0242	3.7
23	0710	100		inoperative	17	23.9	1.0212	6.4
24	0716	45	0	inoperative	23	22.8	1.0222	6.4
25	0823	60	40	inoperative	34	24.4	1.0213	5.2
26	0725	55	30	inoperative	66	26.1	1.0200	3.7
27	0715	90	50	inoperative	53	26.1	1.0196	1.8
28	0715	100	60	inoperative	62	26.1	1.0183	4.9
29	0710	90	75	inoperative	58	26.4	1.0183	2.4
30	0720	100	60	inoperative	99	26.1	1.0186	2.7
31	0800	80	65	inoperative	143	26.1	1.0202	2.4

## PART VI: WATER LEVELS

Since 1978, the National Oceanic and Atmospheric Administration (NOAA)/National Ocean Service (NOS) has operated a primary tide station (No. 865-1370) at the seaward end of the FRF pier. A Leupold-Stevens digital recording float-type tide gage is used to collect instantaneous water level data every 6 minutes throughout the month.

The variation in water level during the month is shown in Figure 4 along with a list of mean and extreme values. This presentation is useful in identifying effects of both meteorological and astronomical forces on the open coast water level.

Table 6 contains the time at the center of each 12.42-hr tidal cycle and the range, high, low, and mean water levels during each tidal cycle.

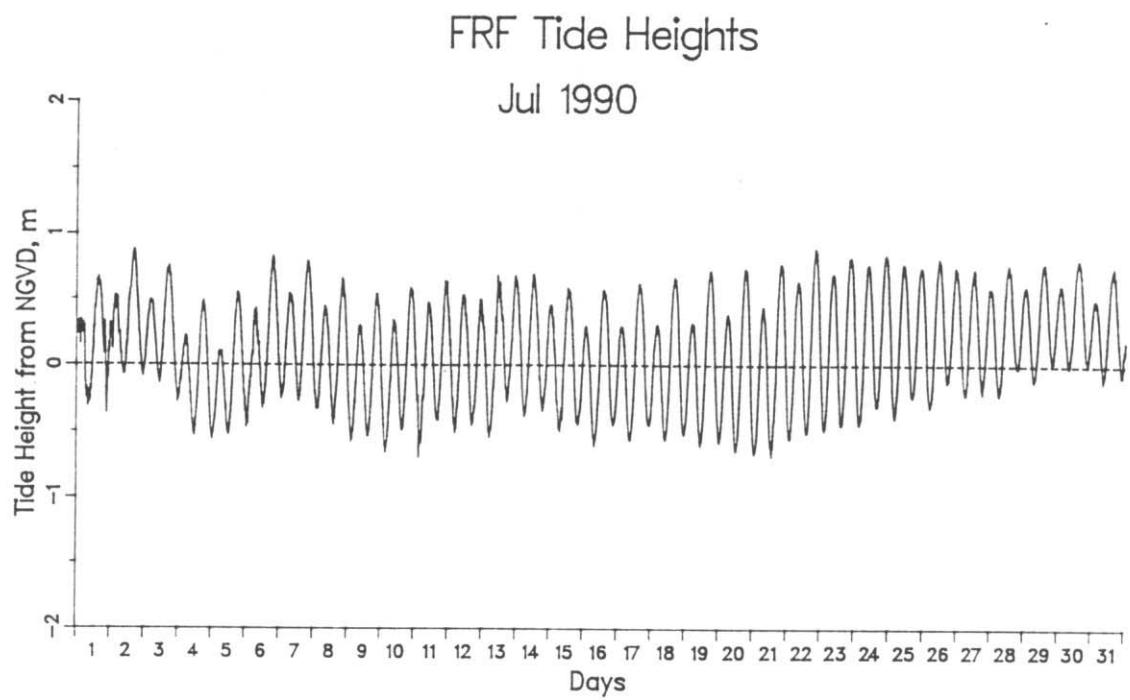


Figure 4. Water Level Time History

Monthly Water Levels, m NGVD

Extreme Low	=	-0.69	on day 11 at 230 EST
Extreme High	=	0.89	on day 22 at 1918 EST
Monthly Mean	=	0.12	
Mean Low	=	-0.38	
Mean High	=	0.63	
Mean Range	=	1.02	

Table 6: Water Levels.m NGVD

		Jul 1990			
Mid-Cycle	Day Time	Low	High	Mean	Range
	1 612	-0.31	0.44	0.06	0.75
	1 1837	-0.36	0.67	0.30	1.03
	2 703	-0.07	0.56	0.23	0.64
	2 1928	-0.08	0.88	0.37	0.96
	3 753	-0.14	0.51	0.22	0.64
	3 2018	-0.28	0.76	0.22	1.03
	4 843	-0.53	0.22	-0.13	0.75
	4 2109	-0.56	0.49	-0.05	1.05
	5 934	-0.53	0.30	-0.15	0.83
	5 2159	-0.47	0.55	0.05	1.02
	6 1024	-0.33	0.59	0.09	0.92
	6 2249	-0.25	0.83	0.26	1.08
	7 1115	-0.27	0.62	0.18	0.89
	7 2340	-0.33	0.79	0.19	1.12
	8 1205	-0.45	0.51	0.05	0.95
	9 30	-0.58	0.66	0.00	1.24
	9 1255	-0.54	0.42	-0.07	0.96
	10 121	-0.66	0.55	-0.09	1.20
	10 1346	-0.49	0.53	-0.02	1.02
	11 211	-0.69	0.59	-0.01	1.28
	11 1436	-0.41	0.59	0.06	1.00
	12 301	-0.51	0.64	0.05	1.15
	12 1527	-0.45	0.53	0.04	0.99
	13 352	-0.55	0.66	-0.01	1.20
	13 1617	-0.28	0.68	0.20	0.96
	14 442	-0.39	0.68	0.14	1.07
	14 1707	-0.35	0.69	0.14	1.04
	15 532	-0.50	0.52	0.00	1.02
	15 1758	-0.45	0.59	0.02	1.03
	16 623	-0.61	0.49	-0.11	1.10
	16 1848	-0.45	0.57	0.03	1.02
	17 713	-0.57	0.51	-0.08	1.07
	17 1938	-0.45	0.62	0.04	1.07
	18 804	-0.56	0.53	-0.07	1.09
	18 2029	-0.52	0.67	0.04	1.19
	19 854	-0.61	0.50	-0.08	1.10
	19 2119	-0.58	0.72	0.04	1.30
	20 944	-0.65	0.46	-0.09	1.11
	20 2210	-0.67	0.74	0.00	1.41
	21 1035	-0.69	0.44	-0.08	1.13
	21 2300	-0.55	0.77	0.10	1.33
	22 1125	-0.51	0.64	0.10	1.15
	22 2350	-0.49	0.89	0.18	1.38
	23 1216	-0.45	0.70	0.14	1.15
	24 41	-0.45	0.83	0.18	1.27
	24 1306	-0.31	0.77	0.24	1.08
	25 131	-0.40	0.84	0.22	1.24
	25 1356	-0.24	0.77	0.27	1.01
	26 222	-0.32	0.75	0.21	1.07
	26 1447	-0.13	0.81	0.33	0.94
	27 312	-0.22	0.75	0.25	0.97
	27 1537	-0.21	0.73	0.25	0.95
	28 402	-0.23	0.59	0.20	0.81
	28 1628	-0.02	0.77	0.35	0.79
	29 453	-0.12	0.60	0.25	0.72
	29 1718	0.02	0.78	0.39	0.77
	30 543	-0.02	0.68	0.32	0.69
	30 1808	0.00	0.81	0.39	0.81
	31 634	-0.12	0.57	0.23	0.69
	31 1859	-0.08	0.75	0.33	0.83

## PART VII: NEARSHORE PROFILES

A. Nearshore Profiles. In order to document profile response away from the pier, surveys of four profile lines extending 900 to 1,000 m from shore and located 489 and 581 m north and 517 and 608 m south of the FRF pier are conducted bi-weekly, after storms, and during more complete bathymetric surveys.

These profiles are obtained using the CRAB-Zeiss surveying system; a Zeiss Elta-2 first-order, self-recording electronic theodolite distance meter in combination with the Coastal Research Amphibious Buggy (CRAB), a 10.7 m high, self-powered, mobile tripod on wheels.

Figure 5 shows the last survey in June and the only survey in July on profile line 188, located 517 m south of the pier. The 30 m shoreward movement of the nearshore bar (160 - 240 m) is the only significant change to the profile.

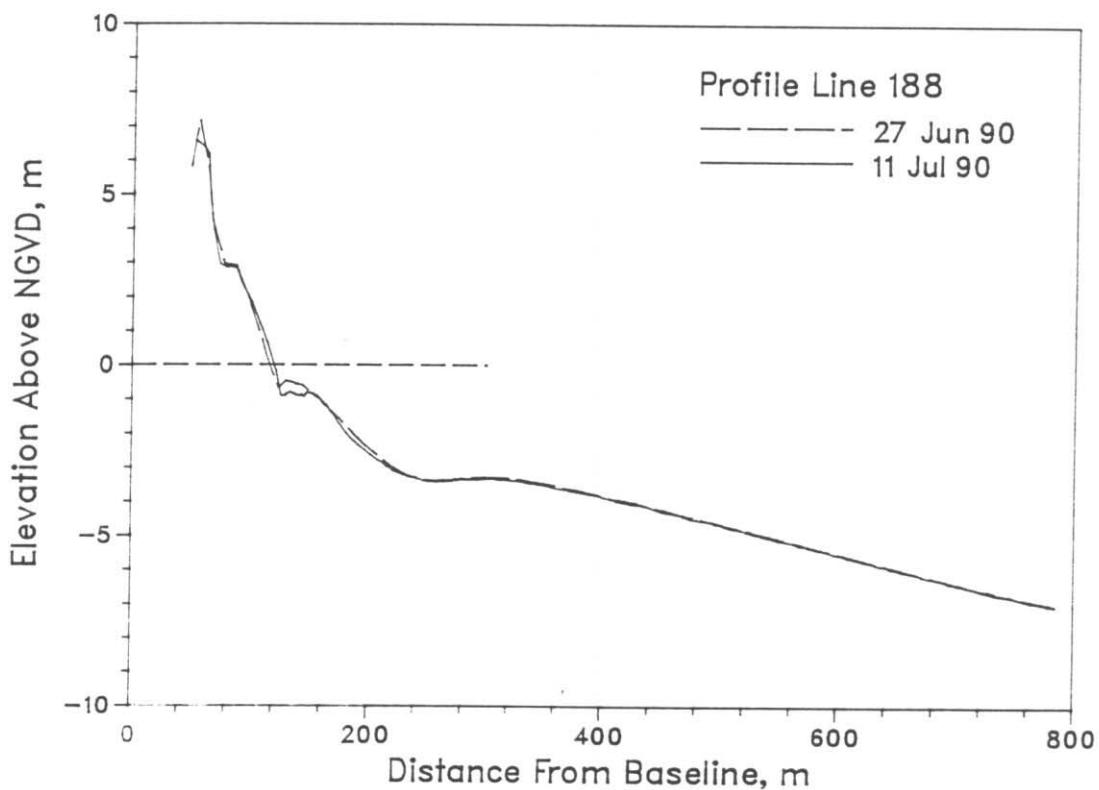


Figure 5. Monthly CRAB profiles on profile 188 - 517 m south of pier.

The profile envelope (Figure 6) reflects the maximum changes that occurred on the profile during 1990. The small change to the envelope (200 m) was caused by the movement of the nearshore bar.

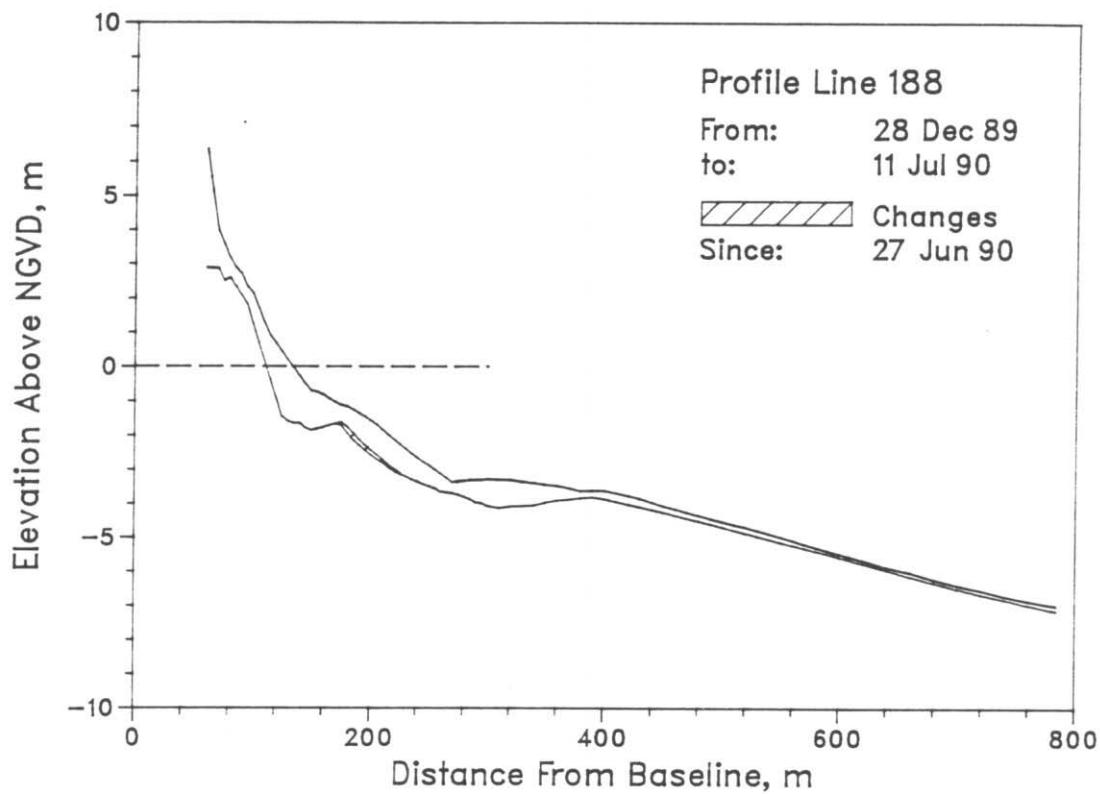


Figure 6. CRAB profile envelope - profile 188.

B. Bathymetry. Figure 7 includes a two- and three-dimensional contour map and a change plot derived from the bathymetric survey on 27 June. Wide contour lines on the change diagram represent eroded areas; thin lines indicate deposition. There was no bathymetric survey during July, the June survey is included for reference.

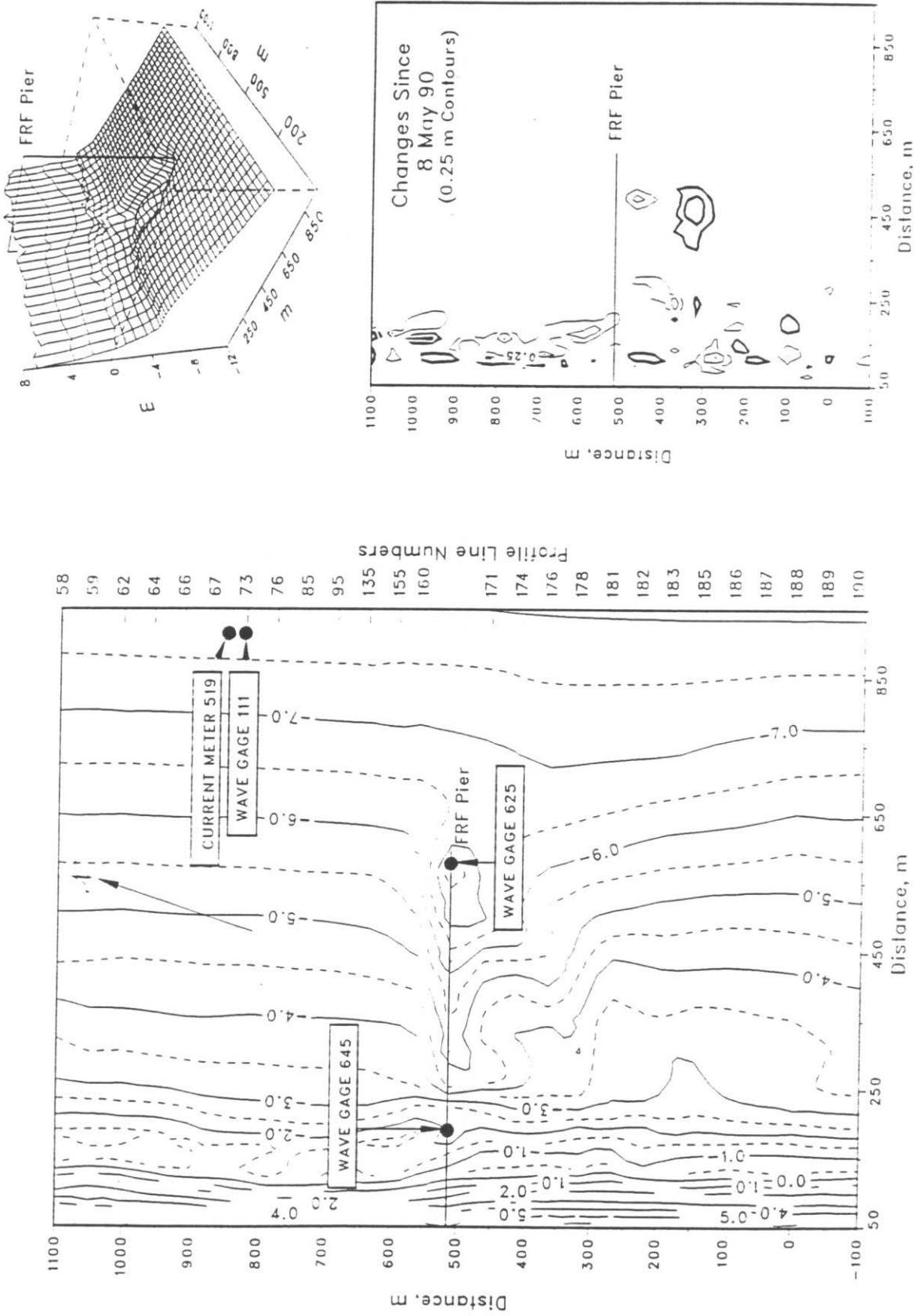


Figure 7. FRF bathymetry 27 Jun 90 depths relative to NGVD

### Distribution List

#### Government Agencies:

OCE	U.S. Geological Survey
BERH	U.S. National Park Service
NAO	U.S. Naval Academy
NASA/Wallops Flight Center	U.S. Naval Civil Eng. Lab
NOAA (NOS, NWS)	U.S. Naval Fac. Eng. Com.
SAD	U.S. Naval Oceanographic Off.
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